

NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION
CONDUCTED JOINTLY BY THE
STATE DEPARTMENT OF AGRICULTURE
AND THE
N. C. STATE COLLEGE OF AGRICULTURE AND ENGINEERING
RALEIGH AND WEST RALEIGH
DIVISION OF AGRONOMY



TYPICAL FIELD OF BRIGHT TOBACCO AND CURING BARNs

Tobacco Culture in North Carolina

By E. H. MATTHEWSON AND E. G. MOSS

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TOBACCO CULTURE IN NORTH CAROLINA

BY E. H. MATTHEWSON AND E. G. MOSS¹

The cultivation of tobacco in North Carolina began with the earliest pioneers, constituting at first a frontier from the Virginia settlements. The first permanent settlement was made by Virginians about 1660 on the Chowan River. As in Virginia, therefore, tobacco growing in North Carolina began on the river lands of the coast country, but settlers constantly made way westward into the upland sections, where it was found that a more satisfactory quality of tobacco could be produced, and its cultivation was finally completely abandoned on the river low-grounds.

In the earlier days, and up to about 1870, the tobacco grown in North Carolina moved to market largely through the earlier established Virginia markets, Petersburg, Clarksville, Danville, and others. The growers would prize the tobacco into stout hogsheads and roll them many miles to these distant markets, the trip often taking several days. Fayetteville, at the head of navigation on the Cape Fear River, and similar towns on the Neuse and the Roanoke, served as shipping centers for considerable quantities of North Carolina tobacco. From these points the tobacco was floated down to tide-water, reaching ocean navigation at such towns as Wilmington, New Bern, and Edenton.

The type of tobacco produced in North Carolina has always been similar to that produced in the border counties of Virginia. Up to the time of the War of Secession, the development was toward a light red or mottled tobacco of the French export type and suitable also for fillers and wrappers for plug, which was the popular form in which tobacco was used in domestic consumption prior to the war. The flavor and odor of smoke was objectionable on these types, and they were therefore largely air-cured or fired but lightly—sufficient to prevent damage from mold or “houseburn.”

The first development toward the modern system of flue-curing was in the use of charcoal as a source of heat, which is practically smokeless. Numerous piles of the glowing coals were scattered over the earth floor of the curing barn. Blackened spots of soil indicating the location of coal pits may still be seen here and there on the farms of the older tobacco districts of the State. Many men in North Carolina of the older generation now living have burned charcoal and used it in curing tobacco.

MODERN DEVELOPMENT

The really important development of tobacco growing in North Carolina to its essentially modern basis has come almost entirely since the

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Civil War. A number of factors have contributed in making the development of the past fifty years possible. Among the more important of these influences may be mentioned:

1. The introduction of the modern system of curing by means of flues with furnaces fed from the outside of the barn, a much easier method; the heat could be better controlled and the cures were much more uniform and satisfactory.

2. The introduction of commercial fertilizers, enabling the grower to greatly increase his yield and often improve the quality of the tobacco and therefore the profit from its production. The soils suited for tobacco were naturally rather infertile. Before the introduction of fertilizers the cultivation of tobacco was of necessity largely confined to freshly cleared land. Fertilizers, however, made it profitable to cultivate old as well as freshly cleared land, thereby rendering more readily possible the great expansion that has followed.

3. About this time, also, in the late '60s and '70s of the last century, the consumption of smoking tobacco in the granulated form for pipe and cigarette began to increase greatly, thus steadily enhancing the demand for the North Carolina type of tobacco. The Dukes, Blackwells, and Carrs of Durham were pioneers in introducing and stimulating the demand for these types. A little later the machine-made cigarette still further added to the demand for the higher priced and more profitable grades of bright flue tobacco.

A fourth influence in stimulating the production of this type was the concurrent rapid expansion in the foreign demand. Flue-cured tobacco is one of the mildest and most beautiful in appearance among the tobaccos of the world. It is pleasantly aromatic and is perhaps unrivaled in general popularity and all-around adaptability for all purposes except standard cigars and snuff. It is widely used both in the United States and abroad for pipe smoking and cigarettes, and in domestic trade is also extensively used for chewing in the form of plug.

EXTENSION OF PRODUCTION

In the '80s of the past century the extension of tobacco-producing area was mainly toward the west. At one time Asheville and Marshall in Buncombe and Madison counties, respectively, were quite important tobacco markets. The Census of 1879 credits the State with a production of 26,986,213 pounds of tobacco and that of 1889 with a production of 36,375,258 pounds.

But it was during the succeeding decade of the '90s that the most remarkable expansion of production took place, this time into the coastal plain section of the State, to the east and southeast of Warren, Franklin, and Wake counties. The spread of production was very rapid, so rapid, in fact, that the 1899 census showed a production of 127,503,400 pounds, an increase for the decade of more than 350 per cent. This period of expansion culminated in the great crop of 1903,

after which there was considerable retrogression and fluctuation, particularly in the new area of the coastal plain, or New Belt, as it was called, due to lower prices for tobacco and higher prices for cotton, causing considerable shifting of acreage.

The crops of 1913, 1914, 1915 again showed marked tendency toward expansion, especially in the New Belt section, the crop of 1915 being probably the largest ever grown there up to the time of the present writing, 1916. This expansion of the past few years came somewhat as a sequel to the reduced crops of 1911 and 1912, due to unfavorable seasonal conditions, but more largely to the tendency to expansion in smoking tobacco and cigarettes in the home trade and to a large expansion in foreign demand, particularly in the Orient. Prices were high, particularly for smokers and cutters, of which the major portion of the new production normally consists.

POSITION OF NORTH CAROLINA AS A TOBACCO GROWING STATE

The total tobacco crop of the United States in round numbers amounts to about 1,000,000,000 pounds per annum. Of this, the flue-cured type now amounts to about 300,000,000 pounds or approximately 30 per cent, and is produced almost entirely in the contiguous territory of southern Virginia, northern and eastern North Carolina, and northeastern South Carolina. North Carolina produces upwards of three-fifths of the flue-cured or bright type, and among the States stands second in total quantity of tobacco produced, being exceeded only by Kentucky.

In manufactured tobacco North Carolina is preëminent, the output being upwards of 100,000,000 pounds annually. Winston and Durham are among the very largest tobacco manufacturing centers in the country, and Reidsville is also a manufacturing center of importance.

IMPORTANCE OF TOBACCO GROWING IN THE STATE

The annual value of the tobacco crop of North Carolina is from \$15,000,000 to upwards of \$25,000,000. Among the other crops of the State, cotton alone brings the farmers more ready money. According to the Census of 1909, tobacco was produced in quantities of commercial importance (250,000 lbs. or more) in 39 of the 100 counties of the State. In most of the Old Belt counties tobacco was the major money crop, and it ranked second to cotton only in most of those of the New Belt. In the Old Belt section of the State cotton is grown but little, while in the new or coastal plain section cotton is nearly always the money crop of first interest and importance; but even here there are several counties in which tobacco is about equal in value to cotton or is a fairly close second.

In the table below are listed the counties of the State in which tobacco was produced in quantities of 250,000 pounds or more. The figures were taken from the census report of 1909.

*Production of Tobacco in North Carolina in 1909 by Counties.
The 13th Census Figures are the Basis.*

COUNTY	Old Belt Section		New Belt Section	
	Acres	Pounds	Acres	Pounds
Pitt.....			14,130	10,973,950
Rockingham.....	14,701	8,279,194		
Granville.....	13,645	7,073,646		
Stokes.....	11,944	7,694,827		
Wilson.....			11,285	7,092,890
Nash.....			11,438	7,070,686
Person.....	11,858	6,904,306		
Caswell.....	11,196	6,435,570		
Greene.....			9,011	6,645,524
Lenoir.....			8,337	6,588,205
Surry.....	10,417	5,715,414		
Wake.....	8,101	4,478,073		
Johnston.....			5,862	3,960,831
Robeson.....			4,263	3,773,910
Vance.....	6,629	3,854,390		
Forsyth.....	6,290	3,592,237		
Wayne.....			5,235	3,439,063
Duplin.....			4,024	3,206,817
Franklin.....	5,909	2,873,878		
Guilford.....	5,052	2,798,325		
Edgecombe.....			4,009	2,637,005
Yadkin.....	4,431	2,258,606		
Durham.....	3,424	1,995,807		
Alamance.....	3,306	1,878,225		
Martin.....			3,183	1,813,278
Orange.....	2,936	1,772,103		
Warren.....	2,632	1,543,378		
Columbus.....			1,854	1,506,201
Beaufort.....			1,717	1,347,841
Craven.....			1,662	1,238,282
Jones.....			1,304	1,083,943
Onslow.....			1,229	1,053,769
Davidson.....	2,019	1,066,331		
Halifax.....			1,560	924,435
Sampson.....			1,184	826,358
Davie.....	1,147	578,431		
Bertie.....			877	570,356
Chatham.....	1,110	543,404		
Carteret.....			291	266,360
Miscellaneous.....	1,702	815,128	937	643,186
Totals.....	128,498	72,150,273	93,392	66,442,890

Total production of State in 1909:

	Acres	Pounds
Old Belt.....	128,498	72,150,273
New Belt.....	93,392	66,442,890

Entire State..... 221,890 138,593,163

Average yield per acre for State.....	624.6
Average yield per acre for New Belt.....	711.4
Average yield per acre for Old Belt.....	577.0
Difference favor New Belt.....	134.4

Since the census year (1909) there has been a very decided increase in the tobacco production, particularly in the New Belt section, beginning from 1913. This expansion was stimulated by the high prices paid for tobacco, particularly smokers and cutters. Both the home and foreign demand was expanding rapidly in these grades, in the production of which conditions in the New Belt are particularly favorable. There is also a greater supply of available labor in the coastal plain section, inasmuch as a portion of the labor employed in the major crop, cotton, can be shifted to tobacco if it becomes profitable to do so.

This expansion in acreage and production is forcibly illustrated by comparing the official report of sales of the New Belt markets in the season 1914-15 with those of 1910-11.

Sales, first-hand, in the tobacco markets of the New Belt section of the State for the years shown. Compiled from the official reports collected by the State Department of Agriculture.

Market	Period, August, 1914, to August, 1915— Pounds	Period, August, 1910, to August, 1911— Pounds
Wilson.....	23,508,093	9,606,800
Greenville.....	19,639,020	7,469,147
Kinston.....	16,203,857	6,237,568
Rocky Mount.....	12,865,270	4,123,954
Farmville.....	5,838,792	2,023,985
Smithfield.....	4,248,754	1,452,847
LaGrange.....	3,493,876	2,052,287
Zebulon.....	2,842,949	407,394
Snow Hill.....	2,713,286	1,397,936
Goldsboro.....	2,678,477	940,544
Williamston.....	2,536,936	519,171
Warsaw.....	2,436,343	569,256
Washington.....	2,509,978	366,366
Fairmont.....	2,421,857	1,103,305
Robersonville.....	2,207,131	632,049
Wendell.....	2,048,956	392,241
Fair Bluff.....	1,500,319	888,994
New Bern.....	1,367,078	
Wallace.....	902,051	
Ayden.....	722,181	475,863
Spring Hope.....	877,352	
Clinton.....	571,715	267,452
Richlands.....	437,721	716,226
Tabor.....	267,382	
Fayetteville.....	236,389	
Mount Olive.....	265,586	
Whiteville.....	90,231	
Ahoskie.....		242,882
Lumberton.....		178,145
Enfield.....		169,580
Dunn.....		84,286
Clayton.....		43,271
Totals.....	115,630,680	42,361,459

These figures show that the production in the New Belt section was increased nearly threefold during this brief period of four years, but it should be remembered that the production in this section had been about twice as great at the previous high level of 1903 as it was in this much reduced production of 1910, and the figures well illustrate the marked tendency to fluctuation in the coastal plain section.

On the other hand, the table below illustrated the comparative steadiness of planting and production in the Old Belt section where there are no other important competitive money crops, and where labor conditions do not permit of such ready fluctuation in the area planted. While the table shows considerable increase, when the same two years are compared the fluctuation is nothing like so striking as in the New Belt.

Sales, first-hand, in the tobacco markets of the Old Belt section of the State for the years shown. Compiled from the official reports collected by the State Department of Agriculture.

Market	Period, August, 1914, to August, 1915— Pounds	Period, August, 1910, to August, 1911— Pounds
Winston-Salem.....	22,748,614	19,942,917
Oxford.....	8,371,505	6,086,582
Durham.....	7,787,904	4,518,721
Henderson.....	7,783,233	4,596,076
Reidsville.....	5,190,543	5,555,967
Louisburg.....	4,057,681	2,398,825
Roxboro.....	3,994,693	5,305,589
Fuquay Springs.....	3,593,580	628,347
Mount Airy.....	2,978,432	3,986,872
Apex.....	2,315,205	1,116,350
Warrenton.....	2,534,650	1,734,277
Mebane.....	1,690,819	889,968
Youngsville.....	1,894,091	832,433
Walnut Cove.....	1,927,714	
Greensboro.....	1,905,926	1,355,812
Madison.....	1,699,132	1,741,667
Burlington.....	1,659,117	1,924,015
Elkin.....	1,437,864	
Stoneville.....	1,368,178	2,175,660
Creedmoor.....	1,075,628	1,605,644
Pilot Mountain.....	906,905	444,534
Statesville.....	667,230	325,526
Varina.....	245,330	
Vanceboro.....	176,355	
Leaksville.....	146,193	287,694
Milton.....		130,526
Totals.....	88,156,522	67,487,002
All Old Belt Markets.....	88,156,522	67,487,002
All New Belt Markets.....	115,630,680	42,361,459
Total for State.....	203,787,202	109,848,461

An examination of the table giving production by counties shows that the tobacco crop of North Carolina was produced almost entirely in 39 out of the 100 counties of the State, of which 19 were in the Old Belt and 20 in the New Belt section.

The yield per acre in the New Belt was greater by 134.4 pounds than in the Old Belt. This difference may be regarded as about normal, although it would doubtless be found to fluctuate from year to year. The difference of yield is founded on difference of soil: that of the New

Belt or coastal plain section being deeper and of greater uniformity, and it will stand heavier fertilization without injury to the quality of the tobacco produced. Another factor of importance in bringing about this higher yield in the New Belt section is the practice of harvesting the tobacco by the leaf or priming system, permitting of and making desirable higher topping of the plant.

SOILS OF THE FLUE-CURED DISTRICT

Speaking broadly, the current trade differentiations of the flue-cured producing area into the Old Belt and the New Belt sections indicates also a fairly well defined modification in the character of the tobacco produced in these two sections. The best tobacco soils of both the Old Belt and the New Belt are all light and sandy, but those of the New Belt in the coastal plain are lighter and more sandy as a class than are those of the Old Belt in the piedmont section, and these soils, especially the subsoils, become progressively more clayey as one progresses westward towards the mountains. The lighter coastal plain soils characteristically produce a brighter and paler type of leaf than the Old Belt soils, but with less body and richness.

In the western part of the Old Belt, particularly from about Rockingham County, N. C., and Henry County, Va., the rich waxy filler types predominate, while the colors run in a much larger proportion to mahogany or red. Soil adaptation is a very important factor in the production of a satisfactory quality of flue-cured tobacco. It is an influence of fundamental importance in determining the color of the leaf produced, as well as such other points of quality as fineness, richness, and body.

In general, the soils adapted to the production of the flue-cured tobacco may be described as light and sandy to a depth of 6 to 10 inches, underlain with a sandy clay subsoil of a yellowish orange color.

The white soils produce the brightest tobacco, unless offset by some other factor. The clay of the subsoil is an important factor in giving the leaf richness and body, and it is also an aid in retaining fertility. In the coastal plain section some of the soils are such loose deep sands as to constitute an extreme of the bright tobacco type. Such soils will naturally produce a very bright tobacco, but the leaf is likely to be lacking in body and richness; and the soil itself is at a disadvantage in retaining fertility and is not likely to withstand wet weather well.

On the other hand, the soils of the Old Belt section, more especially in the western part, frequently represent the other extreme of being too clayey and too red to produce anything more than a dark tobacco, although generally the leaf will be rich and waxy.

Between these soil extremes of the New Belt coastal plain section, some of them tending to be too extremely sandy and open, and the clayey soils of the western part of the Old Belt section there is to be found almost every conceivable variation in shade, depth, and mechanical structure.

From a chemical standpoint, bright tobacco soils are rather weak, as is to be expected from their high content of sand or silica, but most of them are very responsive to artificial enrichment by means of fertilizer, manure, and soil-improving crops. The relatively light soils which predominate in the New Belt section naturally are less well supplied with mineral plant food, particularly potash, than are the stronger soils of the piedmont section. However, a soil possessing ideal mechanical and chemical qualifications may be entirely unsuited to tobacco unless it has good natural drainage, as it is ruinous to a tobacco plant to stand for any length of time in a water-logged soil.



FIG. 1. A typical field of flue-cured tobacco in the Old Belt.

In the early days of tobacco culture, before commercial fertilizer came into general use, it was the almost universal custom to plant tobacco on "fresh" or recently cleared land. On such land there is an accumulation of readily available plant food; the tobacco grows quickly, matures and ripens early, and cures well. In the Old Belt, therefore, where much of the soil tends to be too strong and clayey, a given soil perhaps will produce a crop of good color and quality when it is "fresh," but will not do so after it has been under cultivation for a number of years. But in the case of the light soil in the coastal plain section those which have been longer under cultivation are preferable because the "fresh" land will make the leaves too thin and lifeless and the bottom leaves will begin to waste away prematurely.

CROP ROTATION SYSTEM

Aside from the natural character of the soil itself, there is no more important matter for the tobacco grower to consider than the manage-

ment of his fields so that in regular order they will be in the best shape for tobacco at the proper time. Indeed, the character of the tobacco produced will depend quite as much on how the fields have been handled in rotation between the successive tobacco crops as upon the fertilizer used or the cultivation given directly to the tobacco crop itself. A good system of crop rotation is also very essential in order to control some of the diseases to which tobacco is susceptible, such as the Tobacco Wilt, Root Knot, etc. It is impracticable to attempt to lay out any definite rotation plan adapted to the needs of all tobacco farms. For the Old Belt section, however, where there is less diversity in so-called money crops and the area of good tobacco soils is more limited than in the New Belt, a rotation in which tobacco is followed directly by oats or wheat and then by two years of grass would undoubtedly be found practicable and suited to the majority of tobacco farmers.

Below are a few possible combinations which might be used in the Old Belt:

First year	Tobacco
Second year	Wheat or oats
Third year	Grass mixture
Fourth year	Grass mixture
Fifth year	Tobacco

If this system of cropping supplemented by liberal fertilizing tends to make the soil too rich for the best results with tobacco, the difficulty could probably be overcome by introducing corn into the rotation directly on the grass sod in place of the tobacco, viz.:

First year	Tobacco
Second year	Wheat or oats
Third year	Grass mixture
Fourth year	Grass mixture
Fifth year	Corn

There is one objection to this plan, namely, corn frequently harbors large numbers of wire-worms, which makes it difficult to get a stand of tobacco because of the attacks of the wire-worms on the young plants as soon as they are set out.

Another variation would be to follow the tobacco with corn, then wheat or oats, to be followed in turn by two years of grass, making a five-year rotation and putting the tobacco on the grass sod as in the four-year rotation first mentioned, viz.:

First year	Tobacco
(followed by crimson clover or vetch plowed under.)	
Second year	Corn
Third year	Wheat or oats
Fourth year	Grass mixture
Fifth year	Grass mixture

Where tobacco land is limited, a shorter rotation often is desirable. Tobacco may be followed by wheat or oats and the field left to grow

up in weeds to be turned under the following winter for the next year's tobacco crop. This practice has been pretty generally followed in some sections of the Old Belt, and has given very good results, but it leaves the land idle in the summer to grow weeds and seed the land, which will be troublesome in the next year's tobacco crop.

If by either of the above rotations the land gets too rich to grow a good quality of tobacco, this can be offset very largely by closer planting and higher topping, and by harvesting the tobacco by prining instead of cutting.

In the New Belt there is a greater diversity of money crops. Cotton, peanuts, sweet potatoes, and soybeans may be mentioned, and, among these, cotton would be the one generally preferred because of its ready market and wide adaptability throughout the New Belt section. Legumes are also much less objectionable on the light coastal plain soils, and in many instances a legume could be introduced in the rotation with benefit. In most cases cowpeas would be found more satisfactory for this purpose, or, on the stiffer soils, where they will hold through the winter, crimson clover or hairy vetch might often be used to advantage. When used, these legumes should generally come in the rotation closely succeeding tobacco, so that any excess of ammonia which they might supply could be used up to some extent by the crops intervening before the field comes to tobacco again. On some of the very lightest unimproved soils tobacco will give good results, even if directly following a turned-under leguminous crop, such as cowpeas.

On the stiffer soils of the New Belt the four-year rotation suggested for the Old Belt, namely, tobacco followed by winter oats (instead of wheat), and then two years in herds grass, would be practicable in some cases. If it is desired to put cotton in the rotation, satisfactory results should be obtained by seeding the field to cowpeas as soon as the oats are removed. The peas could either be mowed for hay or turned under, generally the latter when it is desired to improve the soil. The cotton could follow the peas, after which the field could be planted to tobacco again, making a three-year rotation.

There is some objection in certain localities to having cotton precede a crop of tobacco, which may cause the tobacco to have coarse fibers and in some instances perhaps causing it to speck. This trouble in all probability comes from the excessive amount of nitrogen resulting from the incorporation of so much vegetable matter, the residual from the cotton plants consisting of the immature bolls, leaves and stalk. This objection is not general over the New Belt section and could likely be overcome by reducing the nitrogen in the fertilizer under the tobacco and also by increasing the percentage of potash.

Peanuts or sweet potatoes could be introduced into the rotation if desired either in place of or succeeding cotton. Peanuts are a leguminous crop, but since both the vines and the roots are removed in harvesting (unless for grazing hogs), they may be considered an exhaustive rather than an improving crop. Peanuts should not be grown on

tobacco land where there is danger from tobacco wilt. Sweet potatoes leave practically everything on the field except the potatoes themselves, which are principally starch, and this crop, therefore, tends to improve the soil. The vines decay very rapidly and their plant-food content, although rather small, soon becomes available. Here again the rotations mentioned are to be considered only as suggestive, and any number of variations will readily suggest themselves to a thoughtful farmer; but the importance of maintaining a bountiful supply of vegetable matter of a kind which will not be too rich in nitrogen at the time the field comes into tobacco should always be kept clearly in mind when planning the rotation.

FERTILIZERS FOR FLUE-CURED TOBACCO

Bright-tobacco soils as a class are naturally rather infertile, but they are light and friable and of a character to respond readily to fertilizers, particularly in producing a crop of high money value like tobacco. Fertilizers increase the chances of profit from growing bright tobacco in two ways. They greatly increase the yield, sometimes by 100 per cent or more, and if properly balanced they generally improve the quality. Because of the natural deficiencies of bright-tobacco soils and of the special adaptability of commercial fertilizers to bright tobacco there are no other types of tobacco produced in this country on which fertilizers are so freely used except on some of the high-priced cigar-wrapper types in New England and Florida.

A so-called complete fertilizer, that is, one containing each of the materials ammonia (nitrogen), phosphoric acid, and potash is generally needed and the maximum yield cannot be secured unless each is supplied in sufficient quantity.

No general rule as to the proper proportion or balance between these materials can be given and the farmer must exercise judgment in the matter. The best proportions of the three elements are likely to vary considerably on different fields, according to the soil and its state of improvement. As stated, each of these elements has its effect in limiting the yield; but aside from this, broadly speaking, there is a special effect on the quality of the leaf that may be attributed to each element. Too much ammonia, especially if unsupported by a sufficiency of the other fertilizing compounds, particularly phosphoric acid, will make the tobacco coarse, dark, and late in maturing, with a tendency to damage by "red fire" or dead spots here and there on the leaves. Without a sufficient supply of ammonia, however, the tobacco will be small, thin, and poor, although the color may be good. Potash, like ammonia, improves the body of the leaf, and has a decided value in tending to diminish or prevent "diseasing" or "specking." On the light sandy soils of the New Belt section, especially, potash should be applied much more liberally than is now the general custom.

Phosphoric acid may be considered the most generally needed plant-food material throughout the tobacco-growing region under considera-

tion. It not only increases growth, but hastens maturity, and also strongly tends to brighten the color because of its decided effect in ripening the leaf. By reason of this specific effect in thus improving the quality, phosphoric acid should be used liberally in the tobacco fertilizer, particularly on the better improved soils which from an accumulation of nitrogenous materials might tend to produce a dark coarse leaf. On the other hand, some caution should be exercised not to use it in excessive quantities on unimproved very light soils. On such soils there is naturally danger from premature ripening, or "firing," as it is usually called, and such tendency would be increased by an excessive application of phosphoric acid although increasing the ammonia supply would tend to overcome this difficulty with probably increased yield as well. This largely explains why the turning under of a leguminous crop immediately preceding tobacco on such unimproved very sandy soils may sometimes result in positive benefit.

Generally speaking, phosphates (except as just indicated) and potash may be used freely on flue-cured tobacco without injury to the quality, but it requires nice adjustment of the ammonia supply to give the best results. As stated, too little will make a "poor" thin tobacco of small growth, while too much will tend to make the tobacco dark, coarse, and rank smelling. Ammonia in the soil comes almost entirely from decaying vegetable matter or manure and the quantity of the ammonia to be supplied in the fertilizer will depend largely on how much may be expected from these sources in the soil. A crop of 1,000 pounds of flue-cured tobacco to the acre to produce the leaf, stalk, and roots will need to assimilate about 50 pounds of ammonia (equivalent to approximately 40 pounds of nitrogen). On poorly improved sandy soils, generally producing around 600 pounds of tobacco to the acre under ordinary fertilization (say, 500 pounds of 3-8-3 fertilizer to the acre), the yield and quality generally could be improved greatly and the crop made more profitable by using an increased amount of ammonia in the fertilizer. On such a soil it would not be unreasonable to supply in the fertilizer 40 or 50 pounds of ammonia (equivalent to 250 or 300 pounds of 16 per cent dried blood).

Both phosphoric acid and potash are generally needed on practically all the tobacco soils of the flue-cured district, although potash is perhaps of less importance on the stronger soils of the Old Belt section. Neither of these materials is likely to do harm, and any unused portion will not be lost by leaching (except possibly on some of the very deep loose sands of the coastal plain section), but will remain to benefit succeeding crops of the rotation. It would undoubtedly be wise, therefore, to use these materials somewhat more freely than has been customary. In the New Belt this recommendation would apply more particularly to potash because the soils there are relatively more deficient in that constituent, while in the Old Belt, especially on the more clayey soils, phosphates are more urgently needed, although a considerable increase in the potash used, particularly on the lighter soils, would also be desirable.

For general use it would seem reasonable to recommend as a base the use of from 400 to 600 pounds of 16 per cent acid phosphate per acre and in the Old Belt about 60 to 100 pounds of sulphate of potash (analyzing 48 to 50 per cent actual potash (K_2O) or for the lighter soils of the New Belt 100 to 150 pounds of sulphate of potash per acre.

The amount of ammonia to be used with these quantities of phosphoric acid and potash, as indicated above, would depend largely on the condition of the particular field under consideration. In general, it may be stated that proportionately more ammonia can be used profitably on the light sandy soils of the New Belt than on the stronger Old Belt soils. Another feature of importance, particularly on the western part of the Old Belt section, is the time of harvesting and curing. If the crop ripens and is cured in warm weather, say, up to September 10, the tobacco will naturally tend to yellow well and cure bright, as compared with the same tobacco harvested and cured in the cool weather of late September and October. The normal period for curing tobacco in the New Belt is during July and early in August, which are hot-weather months, and this is a factor distinctly favorable to a good bright cure. Tobacco that ripens and cures during hot weather, particularly if the season be rather dry, can satisfactorily utilize a larger amount of ammonia than when the harvest is in cool weather. Wet weather just before the tobacco is harvested is an additional adverse factor.

Increasing the phosphoric acid, as noted above, will tend to brighten the leaf and thus overcome some of the harmful effects of too much ammonia.

In the Old Belt section under average conditions, especially on the stronger type of soils of the western part, probably about 150 pounds of 16 per cent dried blood (or its equivalent in some other good ammoniate) would give approximately the right proportion of ammonia for the minimum amounts of phosphoric acid and potash mentioned above.

The formula would be as follows:

No. 1—	<i>Pounds</i>
Dried blood analyzing 16 per cent ammonia.....	150
Acid phosphate analyzing 16 per cent phosphoric acid.....	400
Sulphate of potash analyzing 50 per cent potash K_2O	100
Total	650

Such a mixture, while weighing only 650 pounds for an acre of land, would be approximately equivalent to an 800-pound application per acre of a fertilizer analyzing 3 per cent ammonia, 8 per cent phosphoric acid, and 6 per cent potash. If desired, cotton-seed meal (analyzing $7\frac{1}{2}$ per cent ammonia) might be substituted for the blood, using twice the number of pounds.

Possibly a more desirable mixture where the materials are available would be as follows:

Nitrate of soda analyzing 18 per cent ammonia.....	50 lbs.
Cotton-seed meal analyzing 7½ per cent ammonia.....	200 lbs.
Dried blood analyzing 16 per cent ammonia.....	100 lbs.
Acid phosphate analyzing 16 per cent phosphoric acid.....	400 lbs.
Sulphate of potash analyzing 50 per cent potash	80 lbs.
Total	830 lbs.

The cost of the fertilizer shown in the above two formulas will vary somewhat from year to year, but the first one of 650 pounds will generally be about \$10, and the second one of 830 pounds with 15 pounds more ammonia, 5 pounds more phosphoric acid, and 6 pounds less potash, will be about \$13. In certain cases, of course, as when the soil had been considerably improved by the use of manure or leguminous crops, even a smaller quantity of ammonia than here mentioned might give better results. In extreme cases, especially when color is an important factor, the ammonia might be omitted altogether. On the other hand, in the case of the lighter types of soils in the Old Belt, particularly in the eastern part of that section, where the lighter types of soil predominate, the proportion of ammonia in the fertilizer generally could be somewhat larger than that shown in the first formula, probably about what is shown in the second formula.

In formula No. 2 about one-fourth of the nitrogen is obtained from nitrate of soda, the remainder about equally from cotton-seed meal and dried blood. For various reasons it is desirable to get the ammonia from more than one source. A small percentage of nitrate of soda can be used without any serious effect on the quality of tobacco; it is readily available and gives the young plant an early start, and afterwards the dried blood and cotton-seed meal become available in the order named. The indications are that the use of some cotton-seed meal in the fertilizer mixture has a tendency to prevent the bleached-out appearances of the leaf caused from a very wet spell and usually spoken of as "sand drown."

Because of the great scarcity of potash during the European War, attention has been drawn to certain home supplies, particularly wood ashes and tobacco stalks. In contemplating the use of either of these materials, it should be remembered that the potash in each is in soluble form, which will rapidly leach out and be lost if exposed in rainy weather.

Well kept, dry hardwood ashes carry about 5 per cent of potash and pine wood ashes 3 to 3½ per cent. Ashes also contain about 30 per cent of lime. Lime is not to be generally recommended for bright tobacco, but the moderate quantity contained in the ashes used as a source of potash would probably not do much if any harm and might under some circumstances be beneficial, as explained in the section on the use

of lime on page 19. It should be remembered, however, that ashes are not suitable for use in a mixed fertilizer, because if such a mixture stands any considerable length of time the lime may react, with the ammonia compounds of the fertilizer forming gaseous compounds which will escape and be lost. The best way would be to apply the ashes along the row separate from the rest of the fertilizer.

In the New Belt section tobacco stalks are not generally available for use as a fertilizer, because under the priming system they are left standing in the field. In the Old Belt where cutting the entire plant is the custom stalks in considerable quantities are available. If kept from the weather, stalks from the flue-cured district contain generally around 2 per cent of ammonia and from $1\frac{3}{4}$ to $2\frac{1}{2}$ per cent of potash. In the absence of an actual analysis of a given sample, the stalks might be estimated to contain in round numbers about 2 per cent ammonia and 2 per cent potash.

Stalks at the rate of 600 pounds per acre will contain as much ammonia and as much potash as 400 pounds of ordinary 3-8-3 fertilizer. The stalks also contain around 0.6 of 1 per cent of phosphoric acid. If, therefore, 160 pounds of 16 per cent acid phosphate per acre be used in addition to the 600 pounds of stalks, the resulting plant-food value of the stalks and acid phosphate, as judged by analyses, will be the same as 400 pounds of 3-8-3 fertilizer.

The stalks may be ground or not and distributed in the row. Unless ground very fine, however, it will be difficult to mix them uniformly with the acid phosphate, because there is such a great difference in the consistency of the two materials, and it would doubtless be best to apply the stalks separately.

Some growers have expressed the opinion that stalks injure the quality of tobacco, but so far as there is any foundation for this, it is in all probability due to the fact that they have been used like manure, spreading them broadcast in much too large and unknown quantities, so that the tobacco was overfertilized, particularly in respect to ammonia.

In the New Belt section, with the combination of lighter and weaker soils and early harvesting in warm weather, a materially richer fertilizer could undoubtedly be used to advantage in most cases, and for that section a mixture may be recommended for average conditions composed about as follows:

Formula No. 1.

Dried blood analyzing 16 per cent ammonia.....	250 lbs.
Acid phosphate analyzing 16 per cent phosphoric acid.....	500 lbs.
Sulphate of potash analyzing 50 per cent potash (K_2O).....	150 lbs.
Total	900 lbs.

This mixture of 900 pounds for an acre of land would be equivalent in plant-food value to 1,000 pounds per acre of a fertilizer analyzing 8 per cent of phosphoric acid, 4 per cent of ammonia, and $7\frac{1}{2}$ per cent

of potash. On the very lightest soils of the New Belt section, for reasons already mentioned, better results might be obtained by reducing the acid phosphate, say, to 400 pounds, or by increasing the blood (ammonia) to 300 pounds or more, thus narrowing the ratio between the ammonia and the phosphoric acid to 5 or $5\frac{1}{2}$ to 8 instead of 4 to 8, as shown in the formula given.

Fertilizers for tobacco are generally applied in the row, and when used in the ordinary quantities better immediate effects are no doubt realized. When considerable fertilizer is used in the row, even in the quantities mentioned above, it should be thoroughly incorporated with the soil by running a double-shovel plow with narrow teeth along the row before it is bedded. When large quantities of fertilizer are used it might be best to apply at least half broadcast.

In connection with the use of fertilizers it is assumed that the humus supply has been given due consideration, thus insuring a good physical condition and moisture-holding capacity. A tight, drought stricken, or badly drained soil cannot be expected to become very productive just by increasing the supply of plant-food in the form of commercial fertilizers.

In the above discussion no special mention has been made of the relative value of the different sources from which the plant-food material may be derived and this has purposely been omitted for the sake of brevity. It should be stated, however, that the materials mentioned may be regarded as standard, in the light of our present knowledge, and as good as anything now on the market.

As a source of potash, however, the sulphate should generally be given the preference in a tobacco fertilizer. The other materials most likely to be used as a substitute are muriate of potash and kainit. Both of these materials contain large quantities of chlorin, which has a tendency to make tobacco burn poorly. Complaints have frequently been made as to the poor burning quality of flue-cured tobacco from the New Belt section, and it would be unwise to use anything in the fertilizer which would tend to strengthen the basis for this criticism.

BARN MANURE FOR FLUE-CURED TOBACCO

While commercial fertilizers are, and of necessity must remain, the chief reliance of the tobacco grower, barn-lot manure is used to some extent on bright tobacco, although there are opponents as well as advocates of its suitability for this crop. In so far as its use may be considered objectionable, the objection has the same basis as that of other organic materials overrich in ammonia, namely, the tendency to make the tobacco coarser and darker. The lighter and poorer the land in respect to other ammoniates, the more likely is the manure to be found desirable and advantageous. The way in which the manure is used is also an important factor in determining its effect on the quality of the crop. If well rotted, and applied some months before the tobacco is planted, it can generally be used in moderate quantities with decided benefit,

except, as already indicated, on land already rich in ammonia. Where possible, it should be applied in the fall before planting the tobacco, or certainly not later than the first of March. When used at the rate of 2 or 3 tons to the acre it can be applied in the row. When used in larger quantities (5 or 6 tons to the acre is about as heavy as it is generally advisable to use manure for bright tobacco as a direct application), it should be broadcast over the land and either harrowed or plowed in. Only fine, well rotted manure should be used in the row, and it should be applied as much as two months before planting, if possible. In using manure in this way the rows may be laid off in February or early in March and the manure put out and covered with the turning plow. Just before planting time these rows may be reopened with a single-shovel plow, the additional fertilizer applied, and the land rebedded in preparation for setting the tobacco.

Where tobacco succeeds herds grass in the rotation, an excellent method is to apply the manure to the grass during the winter, preceding the last season the field is to stand in grass. This would greatly help the hay crop and give the manure time to become thoroughly decomposed and incorporated with the soil.

THE USE OF LIME ON FLUE-CURED TOBACCO SOILS

Most flue-cured tobacco soils contain sufficient lime to fill direct plant-food requirements, but not enough generally to keep them from becoming rather acid. Their general crop-producing power through enhanced bacterial efficiency usually would be improved if they were occasionally limed. The grass, especially, would yield much better if lime were occasionally used. The direct effect of lime on the tobacco, however, may be somewhat injurious to the quality. By hastening the decay of the vegetable matter in the soil it increases the ammonia supply, and on soils already tending to be overrich the lime will tend still further to make the tobacco dark and coarse, the same as if increased supply of ammonia were rendered available in any other way.

On some very poor soils, however, lime might result in both a larger yield and better quality because of the increased food supply rendered available.

It is somewhat a matter of controversy, also, whether lime does not tend to injure the burning quality of tobacco. When lime is used in the tobacco rotation it seems wisest, therefore, to use it immediately after the tobacco comes off and before the wheat or oats are seeded. It would thus tend to help the immediately succeeding crops, particularly the grass, and would be largely out of the way, so far as its direct effect is concerned, by the time the field is again planted to tobacco. On tobacco lots lime should not be used ordinarily oftener than about once in four years and at a rate not to exceed one ton of ground limestone per acre.

VARIETIES OF FLUE-CURED TOBACCO

A great array of so-called tobacco varieties might be listed, but many of them would represent but little, if any, real variation in type. There is, however, one broad differentiation among the many so-called varieties, based on shape and size of leaf which can readily be observed. Thus we have the broad-leafed types, represented by such standard sorts as Warne and Yellow Pryor, White Stem Oronoco, Big Oronoco, Adcock, Willow Leaf, Gooch, Tilley, and Hester, and the narrow-leaf sorts, as Narrow Leaf (little) Oronoco and Flanagan.

Throughout the New Belt and on the lighter soils of the Old Belt section the broad-leaf types are generally preferred, as they are better adapted to the production of smokers, cutters, and wrappers. On the stronger soils of the western part of the Old Belt section, particularly westward from Rockingham County, N. C., and Henry County, Va., the narrow-leaf sorts are general favorites. These narrow-leaf varieties will make good rich fillers on suitable land, and by somewhat closer planting on improved land a larger yield per acre can be grown without the individual leaves becoming overgrown and coarse. Flanagan and some of its subtypes, particularly the improved Flanagan, are rather large-leaf types, about midway between the narrow-leaf and the broad-leaf sorts, and are well adapted to quite rich land.

The variety known as the Short Stalk Flanagan closely resembles the Narrow Oronoco. The Flanagan types are perhaps the most vigorous growers and heaviest yielders of any of the flue-cured varieties, but they are a trifle later in maturing than the others.

On the fine bright soils the broader leaf types are generally popular, the Warne, the standard wrapper type, being perhaps the most popular of any. The White Stem Oronoco, Willow Leaf, and Gooch are favorites in certain parts of the New Belt section. The Adcock is a great favorite in the noted wrapper-producing section in the southern part of Granville County, N. C. The Adkin is also a popular broad-leaf sort in certain sections of the Old Belt and has the merit of being some days earlier in maturing than most of the other standard sorts, but this earliness is probably somewhat at the sacrifice of yield.

The distance between the leaves on the stalk is somewhat greater on these broad-leaf types than on the narrow-leaf sorts, the spacing being particularly wide in the case of the Adcock. It should be noticed that any of these varieties will have the leaves more closely or wider spaced according to the nature of the soil, especially in respect to moisture conditions. With an abundance of moisture the spaces between the leaves will be wider, and under droughty conditions the leaves will be crowded much more closely together. This is a general principle in respect to all vegetation.

SELECTION AND CARE OF SEED PLANTS

In selecting seed plants close attention should be given to all the points that go to make up the ideal plant according to the standard

which the grower should have clearly in mind. The largest plants in the richest part of the field are not necessarily the best for seed purposes.

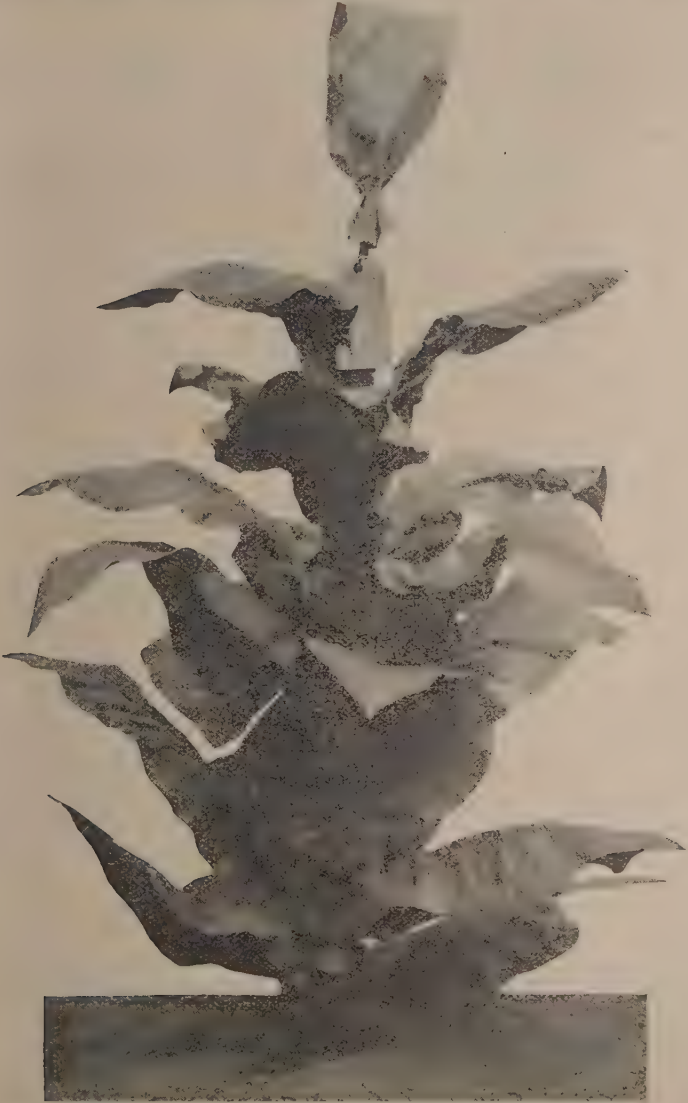


FIG. 2. Seed head of tobacco covered with a paper bag to prevent mixing.

Pure strains of seed can be saved with certainty only by covering the seed head during the blossoming period so as to prevent mixing or cross-

ing with inferior plants or suckers by the passing of insects from flower to flower on different plants. For this purpose an ordinary light-weight but strong paper bag of about the 12-pound size, such as can be obtained at any grocery store, is most practical. A day or two before the first flowers open the bag should be tied about the head (Fig. 2) which first has been trimmed to a "crow-foot." The bag should be loosened and raised up every few days as the seed head grows and the flower débris shaken out.

After all the flowers of the "crow-foot" are open and the seed pods begin to swell, the bag may be removed if desired, but it will be necessary to keep all other flower branches and buds constantly picked off.

In harvesting, only the fully matured and ripe pods should be saved. Such as are underripe should be picked off and discarded. After they have been shelled out, the lighter, imperfect seed should be got rid of by some simple winnowing device, for the same reason that wheat or other seed are cleaned of inferior grain before sowing. A satisfactory separation of the seed can be made also by settling them in a glass of water. After half or two-thirds of the seed have sunk to the bottom, at the expiration probably of two or three hours, the floating seed may be skimmed off and the heavy seed that have settled can be dried on blotting paper.

PREPARATION AND CARE OF THE SEED-BED

It is the almost universal custom throughout the entire flue-cured district to prepare the seed-bed on freshly cleared land, either in the woods or in some other suitable location. The reason for this is that there is an abundance of humus in such land. It is not compacted and baked by heavy rains and the sun, and the plants grow faster on fresh land than on old land.

The particular spot of land chosen should be loamy and mellow, and naturally moist, but having good drainage and free from standing water at all times. It is desirable usually to locate the bed near a stream of water. At such places the land is apt to be naturally moist, and in the event of extreme drought the bed can be more readily watered artificially.

An exposure to the south or east will give the earliest plants, although it is best to have at least two beds, one a little later than the other. The spot chosen should also be as free from weeds or grass as possible and generally, as further insurance against a weedy bed and fungous disease and to kill soil insects as well, the bed should be burned during the winter before it is seeded. If plenty of good dry brush is available (pine brush is best), the bed can be most easily and cheaply burned with this material. About eight good loads of well compacted brush will usually be required for a bed of 100 square yards. Before the brush is piled on the bed, the leaves or other litter should be raked from it, as they hold moisture and would tend to prevent the heat from penetrating the soil to sufficient depth. If brush in sufficient quantity is not avail-

able, or it is desired to burn the land very thoroughly, a combination of wood and brush may be used. Burning in this way will require about 3 to 5 cords of wood for 100 square yards. Long poles or skids are laid along the ground at intervals of about 4 feet. Across the ends of these skids on the upper side of the bed brush and wood is piled about 4 feet wide and 3 feet high. This pile is set on fire in several places. With considerable attention it will generally burn down sufficiently in about half an hour. The embers are then pulled down with hoe or hooks with long handles to the adjacent strip 4 or 5 feet just below. The fires are renewed by piling on more wood and brush and allowed to burn down for another half-hour, or until the soil beneath seems well heated and dried out to a depth of about 3 inches. The process is repeated until the whole bed is gone over. The scarcity of wood in a great many sections of both the New and Old Belts have made the burning of seed-beds very expensive, and in many cases the land is not burned at all, but new places in the woods are located on land well covered with leaves and trash where weed seeds are not likely to be present. In some instances seed-beds have been placed in broom-sedge fields, without burning, and with a liberal application of fertilizers and manure splendid results have been obtained. In preparing a bed without burning care must be exercised to select a place as free as possible from weed or grass seeds. Usually the plants on an unburned bed are a little slow in growing off, but when the weather begins to warm up they will get large enough to transplant as quickly as those on a burned bed.

A spell of dry weather when the ground is free from frost should be chosen for burning. If the soil is wet, it will take much more heat to burn with the same efficiency because of the increased amount of water to be evaporated, and in some cases the physical condition of the soil might be injured if burned when too wet. The bed may be burned at any suitable time during January or February or even as late as the middle of March in the western part of the Old Belt section. The burning of the soil puts it into good tilth, and generally it can be worked up and sowed to best advantage at that time. A disadvantage is the danger of washing the seeds away by heavy rains, or they may sprout prematurely during protracted warm spells in the winter months and be killed by later cold snaps. This, however, rarely happens, and generally the seed will not come up till about the last of February or first of March in the New Belt section or about the middle of March in the western part of the Old Belt section. In fitting the bed after burning, or if fitted without burning, as is sometimes done on weed-free land, a single-shovel coulter plow is of great service. After raking off the embers the bed should be gone over both ways with a single-shovel plow and then several times with a drag harrow. This will minimize the amount of hand work required in fitting to a fine surface tilth. Fertilize liberally by raking in about 1 pound per square yard of some good fertilizer such as 3-8-3 or its equivalent. If the bed has been burned, the ashes will give enough potash, but phosphoric acid and ammonia will be required.

Blood or cotton-seed meal are good forms in which to apply ammonia at the time of seeding, but about the time the plants should come up a top-dressing of nitrate of soda, at the rate of 5 pounds per 100 square yards, will start the plants to growing vigorously. Unless absolutely necessary, nitrate of soda should not be applied to a bed after the plants have attained much size, because it will force them into a late tender growth at transplanting time, and they will be less likely to live.

A moderately heaping tablespoonful of good seed is enough to sow 100 square yards of bed. If too much is used the plants will be spindling from being too thick, and they will not thrive when transplanted. This quantity of seed should be mixed with about 1 peck of good sowing material, such as fine dry fertilizer. In sowing, the bed should be gone over both ways in order to insure an even distribution. One of the best methods of covering the seed is by tramping with the feet. This compacts the soil and presses the seed into it. If the bed is sufficiently smooth a hand roller might be used, but it would not usually be practicable for use on an ordinary bed in the woods.



FIG. 8. Bed of tobacco plants, with the cloth removed, ready for transplanting.

After danger of snow is over, not later than about ten days before it is time for the seed to come up, the bed should be boxed in tightly with poles or plank about 6 inches high and covered with plant-bed cloth. The cloth will retain the warmth and make the plants earlier, and if tight all around and free from holes will keep out flies and other insect enemies. The cloth is kept from sagging to the ground by stretching wire on poles across the bed at intervals of about five steps, or by placing wickets made from green switches here and there over the bed.

About the time the plants begin to come up it is a good plan to sow an additional half tablespoonful of seed over the bed on top of the cloth. The rains will carry the seed through the cloth into the soil, and this extra seeding will make a good late drawing of plants which may prove useful, and in any case will not interfere with the first sowing.

If the beds get weedy they should be picked over by hand, preferably during a spell of wet weather. A few days before transplanting the cloth should be removed to harden the plants, or they may be removed earlier if the plants are becoming overgrown.

Always to have an abundance of plants when needed is a fundamental factor for success in tobacco growing. Without plants the whole year's work is a failure. A good bed may supply as many as 40,000 to 50,000 plants from 100 square yards in two or three drawings, but it is not safe to count on more than 10,000 to 15,000 plants from each 100 square yards sowed. A plant-bed with the cloth removed and plants ready for transplanting is shown in Fig. 3.

EARLY AND LATE PLANTING COMPARED

The transplanting season in the New Belt section begins about the middle of April in eastern North Carolina and continues until as late as the middle of June in the western part of the Old Belt, although even in this latter section the main plantings are made from about the middle to the last of May. In the New Belt the bulk of the crop is generally set by May 1. The tobacco which reaches maturity and is harvested while the weather is yet warm, say, from the middle of August to the middle of September in the western part of the Old Belt section, generally will be decidedly better in quality, particularly in respect to color, than the later cuttings. In the New Belt and the eastern part of the Old Belt the harvest season, running through July and August, naturally comes in warm weather, and this is a distinct advantage, but even there the earlier curings are likely to be best in quality. Fairly early planting is to be preferred, therefore, even in that section, and the plants live better if transplanted before the weather becomes too hot and dry; but in the western part of the Old Belt the grower should make a strenuous effort to have an early crop by planting early and by choosing land on which the plant will grow off quickly.

PREPARATION OF THE SOIL FOR TRANSPLANTING

As already indicated, the best system of tobacco farming, particularly in the Old Belt, will provide for the fall or winter plowing of the tobacco land. The winter freezing will mellow the soil and the winter and spring rains will be better held for the use of the growing crop during the summer. Little faith should be placed in the oft-heard assertion that shallow plowing (3 or 4 inches) is best for tobacco, although in the Old Belt it probably would be unwise to turn up any considerable quantity of a stiff clay; but unless the field can be plowed as much as 6 inches deep without so doing it is probably not well suited to bright tobacco.

If the field has been fall or winter plowed no further preparation will be necessary until in the spring it is time to fit the land for transplanting.

The disc harrow is the best implement for working the soil into a good tilth, if followed by a drag harrow just before laying off the rows.

DISTANCE OF PLANTING

The space allowed each plant in the field, that is, the distance of planting, is a matter of considerable importance in determining the quality and to some extent the yield of tobacco produced. Careful attention should be given the matter of proper spacing when setting out the crop, and a strenuous effort should be made to secure a good, even stand over the whole field as promptly as possible. The real importance of this matter will be made clear by observing the effects of a broken stand of plants on an improved field, just before the harvest. Where the stand is regular, the tobacco will probably be smooth and fine and ripen nicely. But where some of the plants are missing the surrounding plants will be overgrown and coarse, and will neither ripen, yellow, nor cure well. Because of the increased feeding space, without competition from other plants, they are overfed and rendered overgrown and coarse and of greatly diminished value.

In the flue-cured district the customary distances of planting give about 4,000 to 5,000 plants to the acre. In the New Belt it is more usual to space the rows about 4 feet apart, with the plants from 2 to 2½ feet apart in the rows; and in the Old Belt, particularly in the western part, the more common distance between the rows is 3½ feet, with the plants from 2½ to 3 feet apart in the rows. The reason for the wider spacing of the rows in the New Belt doubtless is largely the cause of the greater convenience in getting through the wider rows with the mule and truck used at harvest time for hauling out the leaves, and also because the tobacco grows taller and would thus tend to more self-shading in the narrow row. In some sections of the New Belt it is customary to make every eighth row 6 inches wider than the others, and at harvest time the mule draws the truck or slide, into which the leaves are put, through this wider space with less danger of breaking the tobacco standing in the rows on either side.

As the soil becomes richer by better farming methods, much of the tendency for the tobacco to grow coarse and dark can be overcome by thicker planting combined with somewhat higher topping. In some cases 3½ feet between the rows and 2 feet between the plants in the row would not be too close for the best results in yield and quality.

LAYING OFF THE ROWS AND TRANSPLANTING

For laying off the rows the bull-tongue, single-shovel plow is a good implement. After distributing such fertilizer as is to be used in the row, it should be incorporated with the soil by going along the row

with a double- or single-shovel plow or other suitable implement, after which the rows are bedded by turning two furrows together with a one-horse plow. In a few sections a four-furrow bed is made, on the theory that the wide bed holds the moisture better and gives the plant a better start. In most sections, however, the consensus of opinion seems to be that the two-furrow bed is just as satisfactory. In the light soils of the New Belt the bed is put into final shape for planting by dragging down and slightly packing the top of the ridge. A cotton planter drawn along the row is frequently used for the purpose, the plow in front serving to knock off and flatten the ridge while the roller behind compacts the soil. A plank or log drawn by a mule and wide enough to cover two or more rows at a time is also a satisfactory device. Figure 4 shows an ingenious implement for this purpose devised and used by Mr. B. F. Williamson, a noted grower in Darlington County, South Carolina.



FIG. 4. An ingenious form of ridge flatter for compacting and leveling the beds or lists upon which tobacco plants are to be transplanted.

This device, by means of the spoon-shaped rollers on the front, rounds off the bed so that water cannot form pools and drown the plants, and it flattens and compacts the bed at the same time.

On the rougher soil of the Old Belt section it is more customary to go over the field with a hoe, working through the bed and making a pot at each spot where the plant is to be set. The purpose of the bed is to get a bed of good soft soil in which to set the plant and to provide drainage that surface water during heavy rains may flow away from the plant and not stand around it, and either cover it with soil or throw it outright. But, in obtaining these objects, the hoe the elevation of the plant the better.

A splendid method of preparing the tobacco land in the Old Belt is to drag off the beds with an acme harrow or a spike-tooth harrow; this knocks down the bed somewhat, and at the same time pulverizes the topsoil, also helps to kill some of the grass seed that may have begun to germinate.

When transplanting, so far as possible use only good, strong plants of uniform size. The plant should be kept straight and the roots well mulched and protected from the drying wind and sun in order to retain their vitality as much as possible, which will help materially in insuring a good start in growing. In the flue-cured districts the greater portion of the crop is transplanted by hand in a natural season, using a



FIG. 5. The two-horse machine transplanter at work near Kinston, N. C.

peg for making holes and pressing the earth to the roots. But more or less setting with water in times of drought is resorted to almost every year in some sections. For this purpose a special hand-planter is often used. This is an effective and inexpensive implement. It has the merit of putting the water immediately around the roots where needed, and it is thought that the plants grow better than when set and hand-watered with dippers.

The two-horse machine setter is in use to a limited extent in some neighborhoods, but, of course, is adapted only to smooth fields and soft land. A view of one of these machine setters at work in Lenoir County is shown in Fig. 5. The expense of machine setting is about the same as for hand setting, but there is the advantage of being able to go ahead with the setting when the plants are ready independently of the weather.

The water is put at the roots and the plants live as well or better than hand-set plants.

In three to five days after the field is set it should be gone over again and carefully replanted with the best plants available. A strong effort should be made to secure a perfect stand as soon as possible. This is a very important point in securing the best results from tobacco.

CULTIVATION OF THE GROWING CROP

In order to encourage a quick start in growing, a good horse cultivation and careful hand hoeing should be given the newly set tobacco as soon as it becomes established, generally in about a week or ten days. A little fresh earth should be drawn about each plant, but care should be taken not to loosen the newly established roots. A second hand hoeing may be needed about two weeks later; but in any case the young tobacco should be horse cultivated every week or ten days, according to conditions, until about topping time. After topping cultivation should be discontinued, as the tobacco will ripen better if cultivation is not continued too late. From four to six horse cultivations can generally be given to advantage, although many growers usually give but three. If the soil is at all hard, the first one or two cultivations should be deep to thoroughly loosen up the soil and render it mellow. A double-shovel plow with narrow teeth is useful for this purpose. Later on, as the roots begin to spread through the row, only shallow cultivation should be practiced. For these later cultivations, especially, the ordinary five-toothed cultivator, fitted with an 18-inch or 20-inch sweep on the rear tooth, is a very satisfactory implement. The sweep attachment fills the furrows made by the teeth and works the soil toward the plant. Such a slight raising of the soil along the row is undoubtedly desirable; but it is open to question whether the excessive bedding of the row with the turning plow, as commonly practiced in "laying by" the crop, as it is called, at the last cultivation is desirable, except perhaps in very wet years or on soil characterized as wet or "spouty."

DISEASES AND INSECT ENEMIES

Specking, or "diseasing" as it is generally called, is the most common disease injury to which tobacco in the flue-cured district is subject. It is believed to be a fungous disease, disseminated by spores, perhaps of several species. The trouble is favored by a moist atmosphere and by sappy tobacco. The only practical method of reducing the injury from this trouble, so far as known to the writers, is by using potash more liberally in the fertilizer, which seems to increase the resistance of the plant to the disease.

Root-knot, caused by nematodes or eel worms of semi-microscopic size, also does great damage, particularly on some of the lighter soils of the New Belt section of the State. Nematodes also attack a long list of

plants other than tobacco, and the only way to free a field from the pest is by absolutely clean-fallow cultivation for a year or two or by growing only immune crops for two or three years so as to starve them out.¹

The Granville wilt, first observed in the eighties of the past century, is a bacterial disease communicated through the soil. In the flue-cured district the infested area is largely confined to one soil type in the southern part of Granville County. This soil naturally produces a very fine type of wrapper tobacco. The disease is spreading quite rapidly locally and now occupies a considerable area in that section, embracing one of the very best tobacco areas which we have.

It was formerly thought there was no practical means of controlling the wilt after the soil was once infested, but recent investigation by the North Carolina Experiment Station and the Tobacco office of the Bureau of Plant Industry have demonstrated that it can be controlled by the use of the proper system of crop rotation, and by preventing weeds, many of which were hosts for the wilt bacteria, from growing on the land. However, it is difficult to prevent the wilt from gradually spreading from one field to another, and every precaution should be used to prevent its spreading. While it is largely confined to one soil type, yet it has been observed in different sections of the State during the past two or three years.²

The Mosaic Disease, frequently spoken of as calico or "mottling" and in this State commonly spoken of as "Walloon," probably is the most widespread of all the tobacco disease. Until recently it has been quite generally supposed to be simply a manifestation of malnutrition, caused by unfavorable growing conditions. It has long been known to be infectious, however. It can be spread, for example, by rubbing the leaves of a diseased plant and then likewise rubbing the leaves of healthy plants. Recent tests by H. A. Allard of the Bureau of Plant Industry go to show that the disease is a specific infection, and in the absence of such infection cannot arise from impaired nutrition. It has been discovered that certain aphide, or plant lice, are largely responsible for the dissemination of the disease. Other names, such as frenching, walloon, etc., are applied to a group of diseases resembling true mosaic, more or less. Such diseases as so-called "sore shin" and "rotten stalk" are sporadic and occasional in appearance, and are thought to be due primarily to some mechanical injury which may admit disease germs that attack the tissues locally.

Tobacco at various stages of its growth is subject to the attacks of a number of insect enemies, for a list of which, with recommendations for controlling them, the reader is referred to Farmer's Bulletin 120 and Circulars 120 and 173 of the Bureau of Entomology of the U. S. De-

¹For a full discussion of nematodes and methods of eradication, see "Root-Knot and its Control," U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 217, 1911.

²For a full discussion of the Granville wilt, and methods of controlling same, see Bulletin No., U. S. Department of Agriculture and North Carolina Experiment Station.

partment of Agriculture. Also special bulletin on "Insect Enemies of Tobacco," by N. C. Department of Agriculture, supplement to October, 1909, Bulletin.

TOPPING AND SUCKERING

In about eight or nine weeks after transplanting in seasons of normal growth, the tobacco plants will begin to show signs of sending up a seed head, "buttoning out," as it is called. The topping season is now at hand. In topping the aim is to improve the quality of the leaves produced and to aid the different plants in maturing at the same time. Experience and judgment are necessary in this important operation. From 8 to 12 or more leaves, excluding undeveloped leaves, at the bottom are commonly left to mature on each plant. Primarily, the number of leaves that should be left depends upon the richness of the soil and the vigor of the plant. If the plant is topped too low the yield will be unnecessarily sacrificed and the remaining leaves will be coarse and overgrown. Sometimes in the Old Belt section some of the inferior bottom leaves are primed (broken off) and discarded at the time of topping the plant. In the New Belt, where harvesting by picking the leaves is general, it is customary to top somewhat higher than in the Old Belt, often to as many as 16 or 18 leaves.

The time required for a plant to mature depends somewhat on the number of leaves left on it. In order to bring as many plants as possible to a uniform state of ripeness at one time it is customary to let the bud come out somewhat higher and to top to more leaves at first and to one or two less each subsequent time the field is gone over.

Soon after the plants are topped suckers will begin to grow from the axils of the leaves. The first suckers will appear at the top of the plant and so on downward as the upper ones are broken off. Two full sets of suckers will usually grow on a plant, but it will be necessary to go over the field as many as five or six times at intervals of about one week in order to get them all. The whole object of topping will be defeated if these suckers are allowed to grow, and generally they should not be permitted to get more than 4 inches long before they are removed. Sometimes, however, when a period of wet weather comes just as the tobacco should be getting ripe, it may be of advantage to let the suckers remain temporarily, as their growth will tend to absorb the energies of the plant and prevent the leaves from taking on a second growth, which would make them coarse and dark.

HARVESTING

When the tobacco is to be harvested by cutting the entire plant, as is customary in the Old Belt, the general condition of the whole plant must be considered, allowing the top leaves to get as ripe as possible without too much loss at the bottom of the plant. Generally, a plant will be ripe in from 90 to 100 days after transplanting and in about 35

to 40 days after topping, but this is subject to great variation, dependent primarily upon seasonal conditions. When tobacco is to be harvested by priming, or picking the leaves off as they ripen, the harvest begins whenever the bottom leaves demand it, generally in about two or three weeks after topping or even before topping in some instances. The field subsequently will need to be gone over about once a week until all the leaves are removed, usually about four or five times in all. Fig. 1 shows a fine field of tobacco in the Old Belt section near Oxford, N. C., which is about ready for the harvest, and Fig. 6 gives a view of the field in the New Belt section near Greenville, N. C., which is in actual process of harvesting by the priming method. The more common form of low-



FIG. 6. Harvesting tobacco by the priming method. The form of truck shown, with a high body which passes over the tops of the standing plants without damage, is convenient for hauling out the leaves.

wheel truck for hauling out the leaves is shown in Fig. 7. To cure up sweet and with good color, particularly on the stiffer class of soils of the Old Belt sections, the tobacco must be ripe when harvested, but if overripe it will be lacking in toughness and luster.

The question of comparative merits of the priming method as compared with cutting the entire plant is somewhat complicated by local conditions and is a matter of considerable controversy. Theoretically the priming method, whereby each leaf is taken at approximately its stage of maximum development, should be best. The priming method requires somewhat more labor than the cutting method, and the New Belt section has this labor in better supply, owing to the surplus that can be shifted temporarily from the cotton fields. The lighter soils of the New Belt and the consequent greater tendency in many cases for the

bottom leaves to waste before the top leaves are ripe makes the priming method relatively more necessary than in the Old Belt, where the stiffer soils retard deterioration of the bottom leaves while the top leaves are ripening.

In seasons of normal growth, under the conditions existing in the Old Belt, when all the leaves of the plant mature at approximately the same time, quite likely the crop may be most economically and satisfactorily harvested by cutting the entire plant at one time. But when, as in 1912, a prolonged drought causes the bottom leaves to turn yellow and waste away while the top leaves are still green, there can be no question that it is much better to prime off leaves as they ripen, as was actually done by many growers. If priming had been universally followed in



FIG. 7. Showing a common type of low-wheel truck in the New Belt Section, in which the tobacco leaves are placed as they are picked.

that year, undoubtedly it would have saved many thousands of dollars to tobacco growers of the Old Belt section. Recent experiments conducted at the Branch Experiment Station near Oxford, N. C., by the Tobacco Office of the Bureau of Plant Industry and the North Carolina Department of Agriculture show that the yield may be increased 20 per cent to 25 per cent by priming the leaves off as they mature in comparison with harvesting the plant by cutting. Also present market conditions demand bright tobacco, which can be more uniformly obtained by priming than cutting, consequently more money can be made by priming. For detailed information regarding these experiments write to North Carolina Department of Agriculture for bulletin on "Priming vs. Cutting Tobacco."

CURING AND HANDLING

The expert curer exhibits his skill from the very first as he begins to harvest the crop. He cuts or primes, having clearly in mind what he expects to accomplish in making the cure. For a uniform curing of good color a first requisite is that the barn be filled with plants or leaves of uniform ripeness and character.

The first step in curing is to yellow the leaf properly. This takes place while the plant is yet living but is slowly approaching death from starvation, since the food and moisture supply is cut off. To expose too long to the sun and air after cutting, even though actual sunburning does not result, greatly diminishes the vitality of the cells of the leaf and it will not yellow so well. The tobacco should, therefore, be housed



FIG. 8. Tobacco harvest in the New Belt Section. Stringing the primed leaves under the shade of a tree.

without excessive wilting or long exposure to the sun and wind. As soon as the leaf is dead or dry, further yellowing takes place only very slowly, and if there remains any considerable amount of moisture in the leaf a red or brown color will immediately begin to develop. In curing, one should keep well in mind the principle that it is necessary to preserve the life (cell activity) and at least some of the moisture while the leaf is yellowing, and so manage as to have the moisture exhausted by the time it is completely yellow, or, rather, a little before it is fully yellow, as the most satisfactory cures and clearest colors generally follow when the leaf is dried out with some green remaining in it. Tobacco yellows best, especially in the first stages, when the temperature of the barn ranges from about 50° to 100° F., but it will continue to yellow in the later stages up to 115° or 120° .

As the yellowing proceeds, it is well, towards the later stages, to increase the heat slowly toward these higher temperatures and to begin to dry a little on the yellowest leaves by admitting a little extra ventilation.

In order to obtain the best results in yellowing under varied conditions, it is best to have the barn very tight, so that in the earlier stages of yellowing the desired temperatures may be obtained without exhausting the moisture too rapidly. As the yellowing progresses, however, it is necessary that the moisture be gradually and later more rapidly removed; and to accomplish this to the best advantage it is highly desirable that the barn be so arranged as to be fully and freely ventilated, so that it may be possible to steadily remove the warm, moisture-laden air as it becomes saturated.



FIG. 9. Harvesting tobacco by the whole plant method, showing a good type of hauling frame which should be more generally used.

In drying out an ordinary 16-foot or 18-foot barn, holding, say, 500 sticks of cut tobacco, about 4,000 pounds of moisture (water) must be removed. The movement of the air through ventilation is the only means of getting rid of this large amount of moisture. Raising the temperature of the air increases its capacity to absorb the moisture and creates a draft, provided means are afforded in the construction of the barn for letting out the air rapidly at the top and for letting it in at the bottom. For the outlet at the top a short lever device at each end of the peak for raising the ridge-board by means of wires reaching to the ground, as shown in Fig. 10, is a handy and simple arrangement.

The slit left open when the ridge-board is raised should be about 5 inches wide. To admit air there is always the door, which can be par-

tially opened at will; but this method gives an excess of air immediately in front of and over the door. For an even distribution of the air in all parts of the barn, sewer pipes, about the 4-inch size, set in the walls at appropriate places, will make a good arrangement for the bottom ventilation.

The pipe should be set in the wall close to the ground, but just above it on the outside; they should dip just below the ground on the inside, the opening of the different pipes being, respectively, under and near the ends and at the middle of each length of flue, including the returns. Each air pipe should be fitted on the outside with a suitable wooden stopper to be closed or opened more or less as the conditions of curing require.



FIG. 10. A good type of flue-curing tobacco barn, showing the ridge-pole ventilator raised. The mouth of one of the bottom air inlets is seen just under the open door.

Generally it will be found best to begin to open these ventilators and raise the heat pretty soon after the fires have been started that the moisture may be sufficiently exhausted by the time the tobacco is yellow to prevent reddening or sponging. The draft should not be too strong, especially at first, but it should be sufficient to effectively remove the air before, or at least by the time it becomes saturated.¹

In light-bodied tobacco, as grown on the lighter soil type, the yellowing process will generally take about 36 to 48 hours under average conditions; but if the tobacco is very heavy and dark, as frequently occurs on the filler soil types in the western part of the Old Belt section, it

¹For full description of this barn write for Circular No. 18, "Tobacco Curing Barns," by E. G. Moss, N. C. Dept. of Agr.

may be necessary to consume three or four days in the yellowing process. This will be especially necessary if the soil on which the tobacco was grown was rich in ammoniates or if the tobacco was a little underripe when harvested. Under these circumstances there will be an abnormal quantity of reserve nitrogenous food material in the leaf, and it will be necessary to avoid applying much heat for several days or drying the leaf much, in order that these food materials may be consumed by the life processes of the plants, else the tobacco will be rank smelling, dark, and objectionable rather than sweet and agreeable. This explains why it is such a common practice with those who grow tobacco on the more clayey soils of the western part of the Old Belt to let the tobacco hang in the barn for a day or two before any fire is used at all and then to keep the temperature comparatively low so as to prolong the yellowing period, which in this case is really a ripening and sweetening period as well.

When the yellowing of the leaf is approximately completed, during the latter stages of which the temperature has been maintained at from 110° to 120° F., it is the custom to move up the temperature quite rapidly, say, at the approximate rate of $2\frac{1}{2}$ degrees per hour to 130° or 135° , and to hold it at that point until the leaf itself is entirely dry throughout the barn, or at least on the bottom poles. It is a general rule of curing that it is not safe to exceed this temperature for any length of time before the leaf is dry, because at about this temperature, or a little above, the cells of the leaves are rapidly killed, and when killed they at once release the moisture they contain, which comes immediately to the surface and results at once, by oxidation, in a blackish discoloration known as scalding. Scalding may occur at a much lower temperature than this when the tobacco is full of sap, in the early stages of the cure. When the leaf is dry throughout the barn the ventilators may be partially or perhaps wholly closed, to save fuel, and the heat gradually moved up at the rate of about 5 degrees per hour to about 175° for the light bright types, at which point the heat is maintained until all the stems and stalks are completely killed and dried out and the cure finished.

Tobacco will tend to redden slightly at a temperature of 180° or above. In the filler districts in the western part of the Old Belt section the stems and stalks are more commonly killed out at about 200° ; and sometimes for the last few hours as much as 225° or even more is maintained. These higher temperatures are thought to sweeten the leaf, and a reddish, rich-looking "face" is imparted, known as "scorching." These excessively high temperatures, however, although still extensively used, may make the leaf more or less brittle, which renders it objectionable for chewing purposes.

After the cure is finished the tobacco ordinarily should not be allowed to come in high order for any length of time, especially in warm weather, or reddening and perhaps worse damage from mold or decay

may result. On the other hand, to keep the tobacco for some time in moderate warmth and moisture may be an advantage in eliminating any remaining green color.¹

In the portion of the New Belt adjoining South Carolina a large proportion of the tobacco is generally sold as soon as it is cured, without either assorting or tying the leaves into hands. Of course, the system of priming the leaves as they ripen makes for an approximate grading, since the leaves taken off at any one time are from approximately the same portions of the different plants, representing the bottom, middle, or top leaves, as the case may be. When sold in that way the tobacco is allowed to come in soft order as soon as possible (generally in a day or two) after the cure is finished. The leaves are removed from the string and packed into the wagon body as straight as possible, and the load is immediately taken to the warehouse and sold. In other sections, however, the tobacco is more generally first bulked in the packing house on the stick as it comes from the curing barn, either in the shingle bulk, as is more customary in the New Belt section, or in the square coop, as is more common in the Old Belt section; or it may be hung up in the packing house or curing barn, the sticks crowded closely together to keep the leaf from coming into high order, which would cause it to turn red. The tobacco is then graded and tied into hands at any time convenient to the grower, and sold as desired.

Except in cool, very dry weather, tobacco will generally come into order so that it can be removed from the curing barn on or about the second morning after the cure is finished. All the doors and ventilators should be opened at night to let in the moist air. The web of the leaf will generally become fairly soft the first night. The next day the barn should be tightly closed if the weather is dry, in order to retain the moisture. At night the barn should be again opened fully. The stems generally become softer during the second night, so that the tobacco can be removed and bulked or rehung in the storage or packing house without breaking.

In ordering tobacco for stripping and assorting, an ordering cellar is a great convenience. The cellar generally is dug under the packing house floor to a depth of 6 or 7 feet, and should be large enough to hold at least a curing of tobacco. The cellar is fitted with light framework on which to hang the sticks of tobacco. Care must be taken to locate the cellar where there is sufficient clay in the subsoil so the walls will stand firm, and it must be situated so that water will not rise or flow into it.

It should be banked around outside to keep out surface water, and it would be safest to put a drain pipe in the bottom to carry off seepage. At least one small window also should be provided.

Fig. 11 shows a good type of ordering house and stripping room, which can be cheaply constructed. This building can be either 14 by 28 feet

¹For more detailed information in regard to the process of curing tobacco, see Farmers' Bulletin 523, U. S. Department of Agriculture, entitled "Tobacco Curing."

or 16 by 32 feet, built of logs with a partition about the middle of the building with a door in the center of the partition wall. One end of this building can be used for an ordering pit, or room, the north end for a stripping room, with a window in north end. The ordering room can be dug out 2 or 3 feet, and an open steam box placed across one end immediately in front of the door on the south end opening into the ordering room. This steam box can be used when the tobacco will not soften up fast enough under natural conditions, or, if desired, this room can be built without excavating and depend entirely upon the steam box for ordering the tobacco. This box should extend all the way across the room, so it can be fired from the outside. This ordering and stripping room should be conveniently located, not too far from the packing house.



FIG. 11. Good type of combination ordering house and stripping room.

Frequently a stripping room is built as a shed on one side of the packing house, into which the ordering room opens by a door and steps. The best light, free from glare for stripping, will be obtained if the windows are mostly on the north side of the stripping room.

In assorting tobacco as it is stripped from the stalk, which is a common practice in the Old Belt, about four fundamental grades will generally be obtained from a given plant. There will be the trashy lugs, clean lugs, leaf and tips, as they are taken from the bottom, and then on to the top of the plant. In the actual assortment of an entire curing a number of secondary grades will be made, sometimes as many as eight or ten in all, based upon differences in color, texture, and body. A great number of grades are recognized by the trade, as wrappers, cutters, export leaf, fillers, smokers, etc., and each of these is subdivided into a

number of grades, but, of course, only a few of them would appear in any single crop or curing. The better grades of lugs and leaf are tied into comparatively small hands of about 10 or 15 leaves each, but the poorer lug grades are generally tied into larger hands of 20 to 40 leaves each. The hands or bundles are tied with a leaf, which is folded for this purpose by turning both edges backward and inward so as to form a neat band. This is then deftly given a couple of turns tightly around and partially or completely covering the butts of the leaves forming the bundle, beginning with the tip of the tie-leaf. The butt end of the tie is tucked through the hand between the leaves so as to wedge and hold the tie-leaf in place.



FIG. 12. A side view of house given in Fig. 11, showing the outside construction for ordering room in right end.

Before placing tobacco on the market, it should be brought into good but not too high order, and its appearance will be improved if it is bulked down either on or off the sticks for a day or two. In most sections of the flue-cured district the farmer can dispose of his tobacco either by direct sale on the warehouse floor or through the growers' pooling organization. If sold on the warehouse floor, care should be taken to avoid a glutted market, for at such time the prices are generally somewhat reduced because the buyers cannot handle and take care of it as fast as it comes in.

The entire cost of producing and marketing flue-cured tobacco is estimated at 6 to 10 cents a pound, according to conditions.

Several of the cuts in this bulletin were taken from Department Bulletin No. 16 of the U. S. Department of Agriculture, by E. H. Matthewson, also the general plan of discussion has been followed in this bulletin as in No. 16 of U. S. Department of Agriculture.